3-7 Simplifying Algebraic Expressions

What You'll Learn

To simplify algebraic expressions

🔊 **New Vocabulary**   term, coefficient

Why Learn This?

Simplifying algebraic expressions makes them easier to evaluate.

In an algebraic expression such as $-2x + 8$, the parts that are separated by an addition or subtraction operation are called terms. A **term** is a number, a variable, or the product of a number and one or more variables. The number before a variable is the **coefficient**.

$$7x^2 + 3y$$

terms
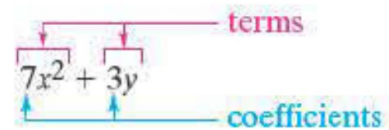
coefficients

Think of an expression such as $a - 3b$ as the sum $a + (-3b)$ to determine that the coefficient of b is -3. When there is no number in front of the variable, it is *understood* that "1" is in front of it. For example, x is the same as $1x$ and $-y$ is the same as $-1y$.

Like terms have exactly the same variable factors. In the algebraic expression $3x + 4x + 14$, the like terms are $3x$ and $4x$. In $40y + 12 - 8$, the like terms are 12 and -8.

You can simplify expressions by using properties of operations to combine like terms. The simplified expressions are equivalent to the original expressions.

KEY CONCEPTS **Properties for Simplifying Algebraic Expressions**

Property	Addition	Multiplication
Commutative	$a + b = b + a$	$ab = ba$
Associative	$(a + b) + c = a + (b + c)$	$(ab)c = a(bc)$

	Addition	Subtraction
Distributive	$a(b + c) = ab + ac$	$a(b - c) = ab - ac$

1 Simplify $6x + (7 + 3x)$ by combining like terms.

$$
\begin{aligned}
6x + (7 + 3x) &= 6x + (3x + 7) &&\leftarrow \text{Commutative Property.} \\
&= (6x + 3x) + 7 &&\leftarrow \text{Associative Property.} \\
&= x(6 + 3) + 7 &&\leftarrow \text{Distributive Property.} \\
&= x(9) + 7 &&\leftarrow \text{Simplify.} \\
&= 9x + 7 &&\leftarrow \text{Commutative Property.}
\end{aligned}
$$

The expression $9x + 7$ is equivalent to $6x + (7 + 3x)$.

Example

1 **Generating Equivalent Expressions** Simplify $8k + (5k + 7 + 11k)$ by combining like terms.

$$
\begin{aligned}
8k + (5k + 7 + 11k) &= 8k + \boxed{5k + 11k + 7} &&\leftarrow \text{Commutative Property.} \\
&= \boxed{8k + 5k + 11k} + 7 &&\leftarrow \text{Associative Property.} \\
&= k(8 + 5 + 11) + 7 &&\leftarrow \boxed{\textbf{Distributive Property.}} \\
&= k(24) + 7 &&\leftarrow \text{Simplify.} \\
&= 24k + 7 &&\leftarrow \boxed{\textbf{Commutative Property.}}
\end{aligned}
$$

✓ Quick Check

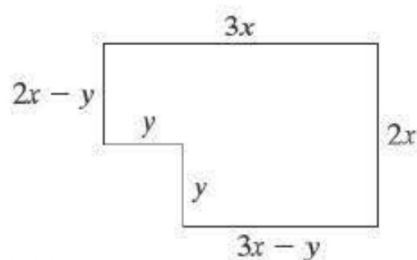**1.** Find an equivalent expression for each expression by simplifying.

a. $2b + 3b + 4b$ ■

b. $2c + 8 + 4c - 3$ ■

Remember, you can rewrite subtraction as addition to help you identify whether a coefficient is positive or negative. For example, when you combine $3r$ and $-r$ it is like adding $3r + (-1r)$. So you get $2r$, not $4r$.

EXAMPLE   Application: Perimeter

2 **Multiple Choice** Mr. Shrake needs to find the perimeter of his yard so he can install a fence. The dimensions of his yard are shown in the figure at the right. What is the perimeter of Mr. Shrake's yard? Simplify your answer.

Ⓐ $4x + 6x$ Ⓒ $10x$

Ⓑ $10x - 2y$ Ⓓ $5x - 2y$

You want to find the yard's perimeter. $P =$ sum of the side lengths.

$3x + 2x + 3x - y + y + y + 2x - y$ ← Write an expression for the sum of the side lengths.

$x(3 + 2 + 3 + 2) + y(-1 + 1 + 1 - 1)$ ← Distributive Property.

$x(10) + y(0)$ ← Simplify.

$10x$ ← Commutative Property.

The correct answer is C.

1. **Vocabulary** What is the coefficient in the term $5x$? ■

Find an equivalent expression for each expression by simplifying.

2. $3x + 9x - 2$ ▮

3. $22y - 19y + 15$ ▮

4. $123 + 13a - 7a$ ▮

5. $10x + 5x - 45 + 7y$ ▮

We will use a game on Calculation Nation called Ker-Splash to practice combining like terms.